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A Statistical Study of the Arithmetical Vocabularies Found in Ten Fourth-Grade Arithmetic Textbooks

Olaf Calmer Kjosness

A STATISTICAL STUDY OF THE ARITHMETICAL VOCABULARIES FOUND IN TEN FOURTH-GRADE ARITHMETIC TEXTBOOKS

By
OLAF CALMER KJOSNESS

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This thesis, presented by Olaf Calmer Kjosness in partial fulfillment of the requirements for the degree of Master of Science in Education, is hereby approved by the Committee on Instruction in charge of his work.

Committee on Instruction

Erich Selke

E. D. Coon

O. L. Kjerstad

J. W. Breitwieser

Director of the Graduate Division

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CHAPTER 1

INTRODUCTION

The Importance of Vocabulary Studies

The ability to use a large and varied vocabulary is looked upon as a measure of intelligence. Terman[1] has said that vocabulary tests will give an intelligence quotient within ten per cent of that secured by using the entire series of Stanford-Binet intelligence measures. Furthermore, the importance of vocabulary becomes more apparent, when considering the fact, that the greater share of the school learning is received through the use of written literature. From the present day standards of measurement, how educated would an individual be considered if he could not interpret the varied literatures?

As a natural consequence, numerous vocabulary investigations have been carried out. The majority of these investigations have attempted to fix a standard of vocabulary attainment for a specific age or grade level. The lists of words used, either have been selected at random or have been taken from a dictionary. Gerlach[2] selected one thousand words from Funk and Wagnall's New Standard Dictionary. Doran[3] selected words from Webster's High School Dictionary and Webster's International Dictionary. Kirkpatrick[4] also assembled the lists of words he gave to his students from the dictionary.

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1. Terman, L.M., Measurement of Intelligence, p. 230.
2. Gerlach, Fred M., Vocabulary Studies.
3. Doran, E. W., A Study of Vocabularies, Pedagogical Seminary, 14, pp. 401-38, 1907.
4. Kirkpatrick, E. A., A Vocabulary Test, Popular Science Monthly, February 1907, pp. 157-64.

The vocabulary of an individual, and especially that of an elementary school pupil, may be divided into the vocabulary of social activity and the vocabulary derived from subject matter or literature. Why did pupils fail in one school subject and do good work in others? Could it be that they did not understand what they were reading? The result was an investigation into the vocabulary of the various school subjects. Vocabulary tests were formulated. The first of such tests to attract wide attention was the one thousand word spelling list compiled by Ayres.[1] Since that time, other lists of important words for the other school subjects have appeared. It is interesting to note, that the majority of word lists have been compiled by analyzing the various textbooks.

The vocabulary tests in the various subjects may be used accurately as a standard of achievement for the subject involved. It is an indisputable fact, that if a pupil does not understand the subject literature, he cannot do well in the subject. Pressey says:[2].

> "A list of the technical terms in any subject is more than a mere list of words; it is a catalogue of the important concepts in that subject...A child's failure to grasp any portion of the subject matter will be indicated by vagueness regarding the meaning of the terms involved in that portion of the subject...The special or technical vocabulary of a school subject thus appears a tool of fundamental importance with which a pupil must become familiar if he is to study that subject with any efficiency. It is the summary of the content of that subject."

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1. Ayres, L. P., A Measuring Scale for Ability in Spelling.
2. Pressey, L. C., The Technical Vocabularies of Public School Subjects. School and Society, Vol. 20, pp. 91-96, 1924.

Previous Vocabulary Studies in Arithmetic

The first studies of the vocabulary used in arithmetic were made by Pressy[1] in 1924, and by Haley[2] in 1926. More detailed work was performed later by Brooks[3]. These investigators worked largely on the basis of frequency, considering no certain grade. Later, Elam and Pressy[4] made a summary of these previous studies, in which they listed 117 concepts as the most important in the field of arithmetic. Buswell and John[5] used 500 words in their investigation, to study children's reactions to arithmetical terms and the development of their concepts of these words from grade to grade. In 1940, Cole[6] published a list of 244 arithmetical concepts as being the most important in arithmetic. O'Rourke and Mead[7] listed 296 words as having arithmetical connotation, in a study of vocabulary difficulties of five third-grade arithmetic textbooks.

The procedure used in determing a technical vocabulary is illustrated best in the studies by Elam and Pressy[4]. They employed the three following steps:

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1. Pressey, L. C., Vocabulary Lists in Fifteen School Subjects.
2. Haley, M. Technical Vocabulary of Public School Mathematics.
3. Brooks, S. S., A Study of the Technical and Semi-technical Vocabulary of Arithmetic, Educational Research Bulletin, 1926, pp. 219-222.
4. Elam, M. K., and Pressey, L. C., The Fundamental Vocabulary of Elementary School Arithmetic, Elementary School Journal, pp. 46-50.
5. Buswell, G. T., and John, Lenore, The Vocabulary of Arithmetic.
6. Cole, Luella, The Teacher's Handbook of Technical Vocabulary.
7. O'Rourke, E. V., and Mead, C. D., Vocabulary Difficulties of Five Textbooks in Third-Grade Arithmetic, Elementary School Journal, XLI (May,1941) pp. 683-691.

1. First, they made a "frequency count" of all the words which they felt applied to the field of arithmetic. They discarded all the words that did not occur a sufficiant number of times. As a result, 274 words were selected on the basis of frequency.

2. The investigators then sent the "frequency list" to outstanding teachers of arithmetic and asked them to rate the words according to the following criteria: a) words considered to be absolutely essential in the teaching of arithmetic, b) words important but not essential, and c) words of little or no value for teaching purposes. As a result 326 words were selected on the basis of importance.

3. The final step was the determination of the social value of the word. In order to have social value, a word must be used outside the arithmetic classroom. The investigators of this particular study used the opinions of teachers as well as their own in determining which words had social value. On this basis, 103 words were selected.

Of the total 703 words, only 117 met all three criteria; of the 117 words, 17 were questioned as to social usefulness.

Need for Further Study

The majority of recent investigations made in the field of arithmetical vocabularies have had to do with the finding of an essential "core" of arithmetical words. These lists include only the "root" form of the word and most of the various endings are counted as such. For example, the words "high" and "highest" are counted as "high". The question arises, if a pupil has acquired the word "high" in his vocabulary, will he also have acquired the word "highest"? The writer thinks not. It is true that the word "highest" may be made more easily a part of the vocabulary, if the word "high" has already been acquired, but some extra effort must be made to affect the acquiring. With an adult it is different. An adult knows what interpretations to give to the various grammatical endings, such as, plurals, the different tenses, comparatives, and superlatives, but the average lower grade elementary pupil has not had the chance to get

and to make effective use of this information.

No study has been made of the more recent arithmetic textbooks, except that made by O'Rourke and Mead[1] in the third grade, to determine what mathematical terms are found. No study has been made, with the exception of the above mentioned, to determine if the arithmetical meaning words have been used a sufficient number of times to be made a permanent part of the pupil's vocabulary. Likewise, no comprehensive study has been made to determine if the various plurals, adjective and adverbial comparatives and superlatives, and verbs of past tenses of arithmetical origin are used a sufficient number of times to be made a permanent part of the pupil's vocabulary.

With the exception of the study by O'Rourke and Mead[1] of the third-grade textbooks, no investigation has been made of the difficulty level of all the arithmetical terms found in arithmetic textbooks. It is true that the essential "core" of words are generally compared to Thorndike's[2] word list or to some other authoritative list. However, these lists do not include many of the arithmetical words which may appear only a few times in a textbook.

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1. O'Rourke, E. V., and Mead, C. D., Vocabulary Difficulties of Five Textbooks in Third-Grade Arithmetic. Elementary School Journal, XLI (May, 1941) pp. 683-691.
2. Thorndike, E. L., Teacher's Word Book of 20,000 words.

CHAPTER 2

THE PROBLEM

Statement of the Problem

The purpose of this study may be summarized in the following steps:

1. To derive a technical and semi-technical list of words having arithmetical connotations which are found in ten modern fourth-grade arithmetic textbooks.
2. To make a frequency count of the above mentioned list of words, including all the different grammatical forms of the "root" words. Also, to make a frequency count of all signs and abbreviations having arithmetical meaning.
3. To determine whether or not the arithmetical words used in the average fourth-grade arithmetic are used a sufficient number of times to be made a permanent part of the pupil's vocabulary.
4. To make a comparative word study of the ten textbooks and thereby determine the arithmetical words most widely used by the different authors.
5. To compare the list of words with Thorndike's Teacher's Word Book of 20,000 words, and thereby determine the level of word difficulty.

Delimitations of the Problem

The writer experienced some difficulty in determining which words should be included in the arithmetical list. The selection as to which words are arithmetical is very simple, in the case of "run", "go" and "if", but it becomes difficult in the case of such words as "final", "cup", "general", and "bank". There are no criteria for determining which words should be included as arithmetical; the writer experienced this difficulty especially in the case of problems. In order to make the list of words inclusive, the writer included all words which were on the so-called "borderline".

Since Thorndike lists only the "root" form of the words in most cases, no comparison can be made to words ending in other grammatical forms. If the assumption is made that the majority of words with different grammatical endings may be listed in approximately the same place as the "root" form of the word, then the derivation of the per cent of arithmetical words included below the Thorndike[1] 4000 word level could be considered with a fair degree of accuracy. Furthermore, Thorndike does not include in his list of words any of the phrases commonly found and used in arithmetic.

Method of Procedure

1. The writer prepared a work sheet composed of a total of 892 expressions, words, abbreviations, and symbols which are associated with arithmetic. In the preparation of this sheet, the word lists by Cole[2] and O'Rourke and Mead[3] were used, together with a brief tabulation of different words found in one textbook by the writer. Different grammatical endings of the "root" forms of the words were also added. All words were arranged alphabetically.

2. The fourth-grade arithmetic textbooks were selected for study. They were of recent publication date and considered to be average fourth-grade textbooks. The books are listed below and will hereafter be identified by the following Roman numerals:

I. Brueckner, Leo J., Grossnickle, Foster E., and Merton, Elda L., Arithmetic We Use, Grade 4, John C. Winston Company, 1942, 278 pp.

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1. Thorndike considers the 4000 word level in his word list as the limit of vocabulary attainment for the fourth grade.
2. Cole, Luella, The Teacher's Handbook of Technical Vocabulary.
3. O'Rourke, E. V., and Mead, C. D., Vocabulary Difficulties of Five Third-Grade Arithmetics, Elementary School Journal, XLI (May, 1941) pp. 683-691.

II. Woody, Clifford, Breed, Frederick S., and Overman, James R., Child-Life Arithmetics. Grade Four, Lyons & Carnahan. 1937. pp. 234.

III. Brown, Joseph C., Mirick, Helen Cook, Guy, J. Freeman, and Eldredge, Albert C., Champion Arithmetics, (stepped-up Edition) Grade Four, Row, Peterson and Company. 1937. pp. 257-512.

IV. Buswell, Guy T., Brownell, William A., and John, Lenore, Daily-Life Arithmetics, Book I, pp. 281-564 (the fourth-grade part). Ginn and Company. 1938.

V. Lennes, N. J., and Traver, L. R., The Lennes Essentials of Arithmetic, Grade Four. Laidlow Brothers, 1937. pp. 152.

VI. Clapp, Frank L., Master Key Arithmetics, Book I, pp. 233-489 (the fourth-grade part). Houghton Mifflin Company. 1937.

VII. Boyer, Philip A., Cheyney, W. Walker, and White, Holman, The New Progress Arithmetics, Book B. MacMillan Company. 1940. pp. 146.

VIII. DeGroat, Harry DeW., and Young, William E., New Standard Arithmetics, Book I, pp. 210-456 (the fourth-grade part). Iroquois Publishing Company. 1938.

IX. Strayer, George D., and Upton, Clifford B., Social Utility Arithmetics. Book 2. pp. 281-577. American Book Company.

X. Knight, F. B., Ruch, G. M., Studebaker, J. W., and Findley, W. C., Study Arithmetics, (grade four) Scott, Foresman and Company. 1940. pp. 9-343.

3. The arithmetical terms on each page of each textbook were tabulated on the work sheet, using one sheet for every four pages of the textbook. A different colored pencil was used for each page, primarily for the purpose for rechecking. During the process of tabulation, expressions of arithmetical meaning not found on the work sheet were added. A frequency count for each word of the various books was then made.

4. Each textbook was rechecked with the corresponding work sheets, in order to eliminate the possibility of errors in counting.

5. A check of the total number of words was made with the Thorndike

word list. From this comparison, the per cent of words above the 4000 word level was computed and tabulated for each book.

6. A table was constructed, showing which words were most widely used by the different authors.

7. Two tables were constructed to make a study of the frequencies of different concepts used in each of the ten textbooks.

CHAPTER 3

THE INTERPRETATION OF RESULTS

In a vocabulary study of this kind, it is necessary to make a frequency count of all the arithmetical concepts found in the various textbooks chosen for study. Table I lists the words alphabetically and the number of times each word is found in each book. The books are listed by Roman numerals and the names of the books can be found by referring to page 8. Each word is rated also according to Thorndike's Teacher's Word Book of 20,000 Words. The interpretation of Thorndike's code is as follows: 1a means the word is found in the first 500 most common words; 1b means in the second 500; 2a means in the third 500; 2b means in the fourth 500, and so on, with 3a, 3b, 4a, 4b, 5a, and 5b. Six means in the sixth thousand, 7 means in the seventh thousand, and so forth until 20 is reached.

The arithmetical concepts used in this study include the "root" form of the word, together with separate entries for all its different grammatical endings. The only exception is in the case of plurals ending in "s"; these are counted as if singular. The list of concepts also includes eight arithmetical phrases, thirty-eight arithmetical abbreviations, and eleven arithmetical signs. This list comprises all the arithmetical concepts found in the ten fourth-grade arithmetic textbooks.

TABLE I

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
about	42	24	73	97	3	27	42	39	25	66	-- 1a
above	61	27	67	39	13	52	14	9	26	65	-- 1a
account	0	1	2	0	21	0	7	0	0	0	-- 1b
accuracy	0	0	0	0	121	0	0	0	0	0	-- 8
accurate	1	0	0	1	0	0	0	0	0	0	-- 7
accurately	1	0	0	2	0	0	0	0	0	0	
acre	0	10	3	3	33	0	0	0	0	0	-- 2b
add	44	109	89	87	81	105	78	80	84	77	-- 1a
added	6	8	4	6	5	4	3	12	4	5	
addend	0	7	2	4	3	3	0	0	0	0	
adding	11	66	16	20	10	32	18	16	22	3	
addition	37	25	38	53	33	36	21	23	34	13	-- 2b
additive	0	0	0	0	0	0	0	2	2	0	
after	15	26	42	50	44	47	28	22	25	49	-- 1a
afterward	0	0	1	0	0	0	0	0	1	0	-- 9
again	8	8	19	24	24	36	19	21	32	22	-- 1a
age	0	0	4	5	0	0	3	0	0	2	-- 1b
ago	4	2	0	6	0	2	2	0	9	4	-- 1b
alike	1	0	1	2	0	1	2	1	6	3	-- 2b
all	130	62	103	172	60	30	56	109	198	177	-- 1a
allow	1	0	3	5	0	0	0	0	0	0	-- 1b
allowance	1	0	6	0	20	6	0	3	1	0	-- 7
allowed	0	0	2	3	1	1	0	0	0	0	
almost	2	0	0	4	0	0	1	0	0	0	-- 1a
already	5	0	3	7	2	0	4	4	1	1	-- 1b
altogether	5	1	7	0	0	0	0	0	0	4	-- 3b
always	18	5	3	22	8	2	4	4	9	6	-- 1a
among	7	4	18	1	4	1	4	11	14	18	-- 1a
amount	22	13	12	29	71	36	27	21	22	12	-- 1b
amounted	0	1	0	1	1	0	3	2	0	0	
amounting	0	1	0	3	1	0	0	2	0	0	
angle	0	0	0	0	0	0	0	0	4	0	-- 4b
annex	0	0	2	0	0	0	0	1	5	0	-- 7
annexed	0	0	1	0	0	0	0	0	0	0	
annexing	0	0	1	0	0	0	0	3	2	0	
another	23	7	18	26	9	17	6	14	24	11	-- 1a
answer	64	188	90	171	860	321	422	125	105	299	-- 1a
answered	9	0	6	1	0	0	0	0	1	11	
answering	0	0	0	1	0	1	0	0	0	0	
any	29	25	41	37	42	36	28	35	47	18	-- 1a
anyone	1	0	0	2	0	7	0	0	0	0	-- 3b
anything	0	7	2	8	0	1	0	2	2	1	-- 1b

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
apart	0	2	0	3	0	0	0	1	3	1	-- 2a
apiece	19	0	3	2	27	43	3	19	0	5	-- 5a
area	0	0	0	12	29	0	0	0	1	0	-- 3a
arithmetic	12	8	17	17	18	2	7	10	7	10	-- 7
around	15	3	21	13	1	9	14	15	29	34	-- 1a
article	6	0	0	0	14	6	2	0	0	0	-- 1b
average	26	35	37	71	56	1	53	48	62	131	-- 3a
averaged	0	4	0	0	0	0	7	0	0	1	
away	12	3	6	11	4	2	3	6	13	8	-- 1a
back	57	2	11	20	11	10	21	15	15	15	-- 1a
balance	0	0	0	0	12	1	0	0	0	0	-- 2b
bank	10	10	36	15	23	19	23	23	15	3	-- 1a
banker	0	0	0	2	0	0	0	0	0	0	-- 5b
banking	0	0	3	0	0	0	0	0	0	0	
bargain	0	1	0	0	0	0	1	0	0	0	-- 3b
barrel	0	0	0	0	0	0	6	9	0	0	-- 3a
barter	2	0	0	0	0	0	0	0	0	0	-- 10
base	0	7	0	0	0	0	1	0	0	0	-- 2a
basic	0	0	0	0	0	2	0	0	0	0	-- 11
before	36	14	22	36	7	35	25	24	20	58	-- 1a
began	6	0	1	3	5	1	6	2	4	13	-- 1b
begin	11	13	7	3	49	13	4	8	6	19	-- 1a
beginning	2	2	3	2	6	3	7	6	6	3	-- 5b
begun	1	0	0	0	0	0	1	0	1	0	-- 2b
behind	0	0	3	0	0	1	1	3	0	0	-- 1a
below	71	113	70	47	98	20	26	30	23	169	-- 2a
beside	4	0	2	8	1	1	4	3	0	13	-- 1b
best	1	0	3	6	0	9	10	12	3	5	-- 1a
better	2	1	6	7	1	6	3	0	9	6	-- 1a
between	28	104	23	20	5	31	4	16	27	30	-- 1a
big	10	1	12	18	1	2	2	3	6	10	-- 1a
biggest	1	0	0	0	0	0	0	0	0	0	
bill	13	15	31	16	22	22	22	49	13	5	-- 1b
block	8	4	17	3	11	0	13	9	8	9	-- 2a
borrow	3	0	1	6	1	8	0	10	1	1	-- 3a
borrowed	5	0	1	0	0	0	7	0	0	6	
borrowing	0	0	1	4	0	4	0	2	0	1	
both	26	1	6	21	35	7	8	32	23	29	-- 1a
bottom	12	1	8	5	17	2	6	6	7	26	-- 1b
bought	86	59	70	52	96	55	75	178	113	54	-- 2a
bring	11	11	19	2	14	9	6	19	24	29	-- 1a
bringing	2	1	0	1	1	0	0	0	0	0	
broad	0	0	0	0	0	0	0	0	0	4	-- 1b

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
brought	10	3	5	12	7	7	2	12	15	28	-- 1a
build	0	0	0	0	1	0	0	2	3	4	-- 1a
builder	0	0	0	0	0	1	0	0	0	0	-- 4a
building	4	1	3	4	7	0	0	2	5	16	-- 1b
built	2	1	2	5	2	2	2	2	5	2	-- 1b
bunch	13	1	6	0	5	0	0	1	7	3	-- 3a
bunches	6	3	4	1	5	0	0	4	16	4	
bundle	6	0	0	2	0	0	0	0	0	0	-- 3b
bushel	17	42	9	15	50	11	44	53	15	10	-- 3a
business	2	5	1	4	0	2	0	1	0	0	-- 1b
buy	64	50	74	33	81	43	50	79	72	54	-- 1a
buyer	0	0	0	0	0	3	0	0	0	0	-- 6
buying	7	14	8	5	6	7	12	16	14	8	
calendar	7	8	2	8	0	1	1	6	2	14	-- 5b
carried	8	1	13	6	5	9	7	3	17	5	
carries	1	0	0	2	0	1	0	1	0	0	
carry	10	2	23	22	12	16	15	11	21	17	-- 1a
carrying	6	0	13	9	3	6	6	13	9	6	
cash	0	1	0	2	29	2	12	2	0	0	-- 3b
cashier	0	5	0	0	0	20	1	0	0	0	-- 6
census	0	1	0	0	0	0	0	0	0	0	-- 10
cent	339	115	78	31	314	147	222	189	49	65	-- 1b
center	1	0	6	2	0	3	1	5	0	0	-- 1b
centuries	0	0	0	0	0	0	0	0	3	0	
century	0	0	2	0	1	0	0	0	6	0	-- 2b
certain	2	0	2	4	2	2	1	0	1	3	-- 1a
change	59	39	34	28	58	52	43	107	57	64	-- 1a
changed	1	0	3	0	3	1	2	0	1	2	
changing	1	0	1	4	0	2	1	3	0	0	
charge	2	3	5	0	0	3	0	10	0	6	-- 1b
charged	0	0	3	0	1	2	2	9	0	6	
cheaper	4	0	2	3	3	0	1	2	0	1	
cheapest	0	0	0	0	0	0	1	1	0	0	
check	51	74	152	72	49	74	28	33	149	42	-- 2a
checked	0	1	1	0	24	5	3	0	0	0	
checking	1	54	11	2	0	11	0	1	1	4	
circle	42	0	8	18	0	28	6	11	16	29	-- 1b
coin	8	7	10	1	0	34	1	17	6	26	-- 2b
collect	4	0	4	3	0	0	0	4	2	1	-- 2b
collected	1	1	1	1	0	1	7	2	4	1	
collecting	0	0	0	1	0	0	1	0	1	1	
collection	2	0	0	3	0	0	0	0	3	0	-- 3b
column	30	25	27	28	11	41	20	38	10	48	-- 3a

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
combination	76	0	3	0	0	3	8	1	0	0	-- 3b
common	0	0	0	2	0	1	0	0	1	0	-- 1b
company	0	1	3	2	0	0	0	1	1	0	-- 1a
compare	19	0	7	7	15	8	2	0	6	17	-- 2a
compared	0	1	0	0	0	0	0	0	1	0	
comparing	2	0	0	3	0	0	0	0	0	0	
comparison	1	0	0	0	0	0	0	0	0	0	-- 4a
compass	1	0	0	0	0	0	0	0	0	0	-- 2b
compasses	0	0	0	0	0	0	0	0	2	0	
complete	8	5	1	9	2	5	0	7	0	0	-- 1b
completed	0	0	0	1	1	4	0	0	0	0	
completely	0	0	0	1	0	0	0	0	0	0	
completing	0	0	1	0	0	0	0	0	0	0	
cone	2	0	9	2	1	4	0	0	2	0	-- 6
contain	9	1	1	15	2	1	1	1	2	0	-- 1b
contained	2	0	5	4	0	2	0	38	10	0	
containing	1	0	0	2	1	0	0	0	2	0	
correct	23	26	41	11	27	79	14	25	0	68	-- 2a
corrected	0	0	0	0	1	0	0	0	0	0	
correcting	0	0	0	2	0	0	0	0	0	0	
correctly	25	11	12	5	2	24	9	10	1	17	
cost	119	93	133	92	256	49	141	160	181	119	-- 1b
costing	1	4	0	1	10	2	0	6	0	1	
count	57	14	11	15	5	37	5	6	9	16	-- 1b
counted	9	4	9	5	0	12	4	12	3	19	
counting	9	7	2	7	0	4	1	2	2	6	
coupon	0	0	0	0	3	0	0	0	0	0	-- 11
credit	0	0	0	0	0	0	1	0	0	0	-- 3a
cube	2	0	0	0	0	0	0	0	0	0	-- 5a
cubic	0	0	0	0	6	0	0	0	0	0	-- 7
cup	10	4	0	9	0	1	7	13	0	5	-- 1b
cupful	2	4	0	0	0	6	0	10	1	6	
customer	1	0	0	0	0	0	0	0	0	0	-- 3b
daily	4	3	3	0	2	29	0	0	1	0	-- 2b
date	14	6	9	7	2	2	4	6	7	3	-- 1b
day	108	129	125	130	108	52	107	130	208	185	-- 1a
debt	0	0	0	0	2	0	0	0	0	0	-- 2a
decade	0	0	10	0	0	0	0	0	2	1	-- 7
decomposition	0	0	0	0	0	0	0	2	0	0	-- 13
decimal	0	0	0	0	0	0	0	0	1	0	-- 12
deep	2	0	1	2	0	0	0	0	2	0	-- 1a
degree	8	8	7	9	1	0	10	10	7	9	-- 2a
deliver	1	2	10	7	0	1	6	6	0	5	-- 2a

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
delivered	1	0	2	6	6	0	7	1	0	5	
deliveries	0	0	1	0	0	0	0	0	0	0	
delivering	0	0	2	3	0	0	0	1	1	1	
delivery	5	0	3	3	0	0	0	0	1	0	
denominate	0	0	0	4	0	0	6	0	0	0	-- 15
denomination	0	0	0	0	0	0	3	0	0	0	-- 11
denominator	0	0	0	12	0	0	0	22	8	0	-- 20
deposit	2	0	0	0	0	0	7	0	0	0	-- 3b
deposited	0	0	0	0	0	0	4	0	0	0	
depth	0	0	0	3	0	0	0	0	0	0	-- 3a
diagonal	6	0	0	0	0	0	0	0	0	0	-- 9
diagram	0	0	0	0	0	0	0	0	1	0	-- 8
dial	0	0	0	0	0	0	0	0	1	0	-- 6
difference	13	11	21	13	7	73	2	10	25	25	-- 1b
different	24	3	7	18	3	7	3	11	9	14	-- 1b
digit	0	0	0	0	2	0	0	0	0	0	-- 16
dime	17	34	20	9	68	40	10	30	13	42	-- 4b
dimension	1	0	0	3	0	0	0	0	0	0	-- 7
distance	10	6	30	9	20	47	7	9	23	18	-- 1b
divide	89	86	86	95	65	84	34	117	114	160	-- 1b
divided	46	31	32	27	14	18	12	41	47	50	
dividend	0	34	20	10	16	15	8	26	16	0	-- 7
dividing	31	23	8	9	1	20	5	44	16	19	-- 13
divisible	0	0	0	0	0	0	0	0	1	0	-- 13
division	108	73	64	104	72	73	42	59	100	65	-- 3a
divisor	4	20	24	15	15	10	6	13	27	16	-- 11
dollar	74	94	67	29	86	50	27	144	41	75	-- 2a
dot	7	0	0	25	5	2	13	1	2	1	-- 2b
double	4	0	5	3	0	0	0	0	0	0	-- 1b
doubled	4	2	0	0	0	0	0	0	0	0	
down	12	22	27	9	14	9	15	18	37	41	-- 1a
downward	0	0	0	2	8	0	0	0	0	0	-- 3b
dozen	36	36	71	12	79	108	35	59	20	49	-- 2a
dry	0	2	2	11	0	0	4	3	5	3	-- 1b
due	2	0	7	0	15	1	5	0	0	0	-- 2a
during	3	9	8	4	8	0	11	12	8	52	-- 1a
each	430	283	437	265	338	318	210	431	438	457	-- 1a
earlier	0	0	0	1	0	0	0	0	0	1	
early	1	0	1	4	0	0	2	1	1	3	-- 1a
earn	18	8	20	4	25	13	22	12	25	20	-- 2a
earned	19	12	27	14	40	16	14	11	32	24	
earning	1	0	2	4	1	4	3	1	1	2	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
edge	1	0	3	2	0	3	0	1	4	0	-- 1b
eight	23	12	29	11	16	9	8	20	10	17	-- 1b
eighteen	11	1	4	2	4	0	0	3	0	0	-- 2b
eighteenth	0	0	0	0	0	0	0	1	0	0	-- 6
eighth	14	5	6	24	1	4	11	22	19	28	-- 3a
eighty	1	6	7	4	3	1	1	5	1	2	-- 3b
either	1	1	1	1	1	0	1	1	1	0	-- 1b
eleven	8	0	1	3	2	1	0	4	0	1	-- 2b
eleventh	0	0	1	0	0	0	0	0	0	0	-- 6
else	0	0	2	7	0	4	0	3	1	1	-- 1b
elsewhere	1	0	0	0	0	0	0	0	0	0	-- 4a
emptied	0	0	0	0	0	0	0	1	0	0	
empty	4	0	3	0	0	2	2	1	1	1	-- 2a
end	5	16	15	7	28	9	17	3	9	26	-- 1a
ended	0	0	0	1	0	0	0	0	1	2	
ending	0	3	3	1	0	0	5	6	1	2	-- 5a
enough	11	4	16	15	3	19	8	5	14	29	-- 1a
entire	0	2	0	0	1	0	0	1	0	0	-- 1b
equal	54	49	38	31	14	85	21	57	70	55	-- 1b
equalled	0	0	0	1	0	0	0	0	0	0	
equally	15	11	42	7	10	6	10	23	46	37	
even	31	0	2	10	0	1	2	0	2	1	-- 1a
evenly	4	0	0	4	0	1	2	1	2	18	
ever	2	1	0	9	0	6	1	0	4	1	-- 1a
every	14	5	10	16	34	2	9	9	10	5	-- 1a
everybody	0	0	1	0	0	0	0	0	0	0	-- 2b
everyday	1	0	0	0	0	0	0	7	1	0	-- 7
everyone	1	0	0	1	0	2	1	1	0	0	-- 4a
everything	0	0	2	1	0	1	1	0	0	1	-- 1b
everywhere	0	0	0	0	1	0	0	0	0	0	-- 3a
exact	2	0	2	4	0	2	2	0	0	2	-- 2a
exactly	5	0	2	3	0	3	5	9	5	3	
example	142	108	132	114	67	4	67	48	32	346	-- 2a
except	0	0	2	4	2	1	2	2	4	2	-- 1b
excepting	0	0	2	0	0	0	0	0	0	0	-- 13
exchange	1	0	2	0	0	0	2	0	0	0	-- 2b
exchanged	1	0	0	0	0	0	1	0	0	0	
exchanging	0	0	4	0	0	0	0	0	0	0	
exercise	4	120	3	0	1	57	3	5	19	0	-- 1b
expense	0	14	3	0	21	2	17	2	10	22	-- 2b
expensive	0	0	0	0	0	0	4	0	0	0	-- 4a
express	1	0	1	2	0	0	1	0	0	2	-- 1b
expressed	0	0	0	1	0	0	0	0	0	0	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
extra	5	0	16	65	1	0	2	10	2	31	-- 4a
fact	66	21	55	98	72	102	26	30	80	5	-- 1b
factor	0	0	0	0	0	1	0	0	0	0	-- 7
far	10	15	11	26	27	29	15	7	16	26	-- 1a
faraway	0	0	0	0	0	0	0	0	2	0	-- 14
fare	11	4	4	0	8	1	0	7	5	11	-- 2a
farther	3	3	2	7	8	13	5	5	3	7	-- 2a
farthest	1	0	1	0	0	0	0	0	0	1	-- 5a
fast	4	3	4	4	1	17	4	0	2	1	-- 1a
faster	5	1	0	3	0	0	1	0	1	3	
fastest	1	1	0	0	0	0	0	0	1	7	
feet	37	16	15	19	62	86	75	69	49	75	-- 1a
few	1	2	0	2	0	1	3	0	0	0	-- 1a
fewer	4	0	22	7	0	0	0	0	1	3	
fewest	0	0	1	0	0	0	0	0	0	0	
fifteen	16	5	5	0	3	4	0	2	0	1	-- 2a
fifth	13	14	3	18	7	6	11	14	9	19	-- 2a
fiftieth	0	0	0	0	0	0	0	1	0	0	-- 12
fifty	4	9	23	4	6	2	1	9	2	10	-- 2a
figure	56	114	56	90	14	35	25	92	77	127	-- 1b
figured	0	1	0	0	0	0	0	1	0	6	
figuring	0	0	0	0	0	0	11	0	0	0	
fill	28	30	14	13	33	9	8	12	15	2	-- 1a
filled	4	1	3	7	0	5	7	6	0	8	
filling	3	0	0	2	0	7	1	8	0	2	
final	1	3	0	0	0	0	3	1	0	0	-- 2a
finally	0	0	0	0	0	0	0	1	0	0	-- 2a
find	197	175	99	178	190	399	74	161	178	201	-- 1a
finding	11	1	7	10	8	23	3	7	17	2	
first	57	59	46	58	31	72	45	47	107	89	-- 1a
five	59	34	46	61	44	25	19	51	14	40	-- 1a
follow	1	3	7	5	4	3	7	3	7	12	-- 1a
followed	0	0	0	0	0	0	1	0	0	0	
following	40	4	10	11	13	2	5	5	67	43	-- 1b
foot	12	5	6	10	15	9	13	9	9	11	-- 1a
form	2	0	0	3	1	0	2	0	2	0	-- 1a
formed	0	1	1	2	1	1	0	1	0	0	
forty	3	6	21	6	9	3	1	8	1	8	-- 2a
found	21	6	23	18	1	40	16	21	16	51	-- 1a
four	66	37	52	78	32	12	32	44	16	53	-- 1a
fourteen	0	0	3	10	2	2	0	1	0	1	-- 3b
fourth	54	29	28	38	14	52	5	37	17	31	-- 1b
fraction	27	12	20	102	3	6	16	85	39	57	-- 5a

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
fractional	1	1	1	3	0	0	15	5	0	0	-- 15
from	129	126	138	124	79	247	65	120	186	176	-- 1a
front	3	2	3	5	0	5	7	1	1	5	-- 1a
full	8	3	2	6	0	1	5	1	0	5	-- 1a
fund	0	3	0	0	0	0	2	1	0	0	-- 4b
further	0	0	0	0	0	0	1	0	0	0	-- 2a
gain	0	3	1	9	17	0	4	0	0	0	-- 1b
gained	0	1	0	3	4	0	7	0	0	3	
gallon	46	30	25	21	58	23	40	44	14	42	-- 5b
gave	32	27	47	14	17	27	27	65	39	72	-- 1a
give	41	27	60	26	60	93	12	121	72	92	-- 1a
given	22	6	14	14	28	187	23	19	4	23	-- 1a
giving	5	1	6	1	0	12	2	6	1	1	
gone	4	5	2	11	1	4	5	3	3	3	-- 1b
graph	0	0	0	6	0	0	9	0	0	2	-- 18
great	0	0	1	3	0	0	1	0	1	0	-- 1a
greater	3	0	0	2	1	3	0	4	3	0	
greatest	0	0	0	0	0	0	0	1	1	0	
greatly	0	2	0	0	0	0	0	0	0	0	
gross	0	0	2	0	0	0	0	11	0	0	-- 4a
group	102	10	10	20	7	4	7	10	23	8	-- 2b
grouped	6	0	0	0	0	0	0	0	0	0	
half	47	48	36	18	19	63	27	47	33	51	-- 1a
halves	4	3	6	8	0	9	2	5	8	7	-- 11
hand	14	35	22	7	21	20	15	38	11	15	-- 1a
handed	0	15	4	0	6	3	0	0	1	3	
handing	0	0	0	0	0	6	0	0	0	0	
heavier	0	0	0	2	1	0	4	2	1	0	
heaviest	0	0	0	2	0	1	0	1	0	0	
heavily	0	0	0	0	0	0	1	0	0	0	-- 4b
heavy	2	1	2	6	0	1	0	3	3	1	-- 1a
height	1	0	5	4	3	15	12	4	14	5	-- 1b
held	0	0	3	4	2	0	2	12	2	0	-- 1b
hence	0	0	0	0	0	0	0	0	16	0	-- 2a
high	5	1	6	13	9	8	12	1	18	16	-- 1a
higher	2	0	6	2	3	0	7	3	5	1	
highest	0	0	1	0	3	0	5	4	3	4	
hired	0	0	1	0	0	0	0	0	1	1	
hold	5	1	8	14	0	8	3	4	13	3	-- 1a
holding	0	0	1	5	0	3	0	8	3	0	-- 19
horsepower	0	0	0	0	0	0	3	0	4	0	-- 12
hour	60	55	70	27	148	137	60	46	65	76	-- 1a
how	937	399	716	609	667	684	303	880	1008	863	-- 1a

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
hundred	62	86	87	57	30	28	24	39	9	40	-- 1a
hundredweight	0	0	4	0	0	0	0	0	1	0	-- 20
inch	50	18	6	4	10	36	9	1	7	16	-- 1b
inches	51	29	37	21	51	159	85	50	41	93	
include	0	0	1	0	0	9	0	0	0	0	-- 2a
including	0	0	3	0	14	0	12	1	0	0	
incomplete	0	0	1	0	0	0	0	0	0	0	-- 10
incorrect	0	0	2	1	0	0	0	0	0	0	-- 9
incorrectly	1	0	0	2	0	0	0	0	0	0	
increase	0	0	0	2	0	0	0	0	0	0	-- 1b
increased	1	0	0	2	0	0	1	0	0	1	
inside	1	0	0	2	3	0	1	0	2	3	-- 2a
instead	6	0	4	12	1	4	0	4	10	12	-- 1b
insure	0	0	0	0	0	0	0	0	0	3	-- 7
interest	0	0	1	0	0	0	0	0	0	0	-- 1b
interesting	4	0	1	2	0	1	2	0	1	1	-- 5b
intermediate	0	0	0	0	0	0	2	0	0	0	-- 9
into	65	29	33	34	5	43	20	44	48	105	-- 1a
inventory	0	0	6	0	0	0	0	0	0	0	-- 11
item	1	0	2	0	4	0	0	0	0	0	-- 4b
keep	3	8	16	19	11	12	7	6	9	3	-- 1a
keeping	0	2	0	0	2	12	0	12	1	0	
kept	5	8	7	7	2	3	2	2	2	16	-- 1b
kind	26	21	6	22	0	10	3	10	7	15	-- 1a
laid	4	0	4	3	0	9	1	2	0	2	-- 1b
large	28	14	15	37	5	15	16	22	36	26	-- 1a
larger	17	15	12	35	3	9	2	20	16	5	
largest	1	0	7	7	1	8	2	9	7	10	
last	14	28	17	33	9	19	8	31	99	48	-- 1a
lasted	2	2	1	0	0	1	0	1	0	0	
late	1	0	1	2	3	3	4	1	9	2	-- 1a
later	0	0	2	0	1	4	2	1	0	3	
lay	2	0	1	4	0	3	0	1	1	0	-- 1a
laying	0	0	0	0	1	0	0	0	0	0	
learn	24	3	5	20	24	11	4	4	6	15	-- 1a
learned	10	11	6	7	1	1	3	5	13	6	
learning	0	3	0	4	1	0	0	0	6	37	
least	1	1	3	4	0	8	1	0	0	3	-- 1b
left	65	52	78	60	41	80	53	68	116	69	-- 1a
length	12	3	7	6	11	32	8	12	23	19	-- 1a
lent	0	0	0	0	0	0	1	0	0	0	-- 4b
less	28	12	13	24	14	25	11	11	23	11	-- 1a
lesser	2	0	0	0	0	0	0	0	0	0	-- 6

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
light	2	0	5	4	0	0	0	1	3	5	-- 1a
lighter	0	0	0	0	0	0	1	1	0	0	
lightest	0	0	0	0	0	0	0	1	0	0	
lightly	0	0	0	0	0	0	1	0	0	0	
like	58	16	14	48	2	42	17	23	55	23	-- 1a
liked	0	0	3	1	0	0	0	3	0	0	
liking	0	0	0	1	0	0	0	0	0	0	
line	12	39	30	30	35	12	25	19	12	10	-- 1a
linear	0	0	1	0	0	0	0	0	0	0	-- 18
lined	0	0	0	1	0	1	0	0	0	0	
lining	0	0	0	0	0	0	0	1	0	0	
list	5	6	4	10	2	15	2	4	0	10	-- 1b
listed	0	0	1	0	0	0	0	0	0	0	
little	14	2	19	16	3	22	7	3	11	19	-- 1a
loan	2	0	0	0	0	0	0	0	0	0	-- 7
long	74	28	48	80	64	165	23	46	91	88	-- 1a
longer	3	7	2	10	2	7	1	3	12	2	
longest	0	1	0	0	0	1	0	0	5	1	
lose	1	1	1	0	0	2	0	1	0	0	-- 1b
loss	0	1	0	0	0	0	1	0	0	0	-- 1b
lost	2	3	2	1	2	0	9	0	1	1	-- 1a
lot	0	25	2	1	5	0	0	2	7	6	-- 1b
low	0	0	2	1	0	0	3	0	0	0	-- 1a
lower	4	1	2	3	1	4	0	2	5	0	-- 1b
lowest	0	1	1	17	2	0	10	15	2	0	
made	32	51	48	58	16	69	41	41	46	67	-- 1a
make	86	44	113	175	25	111	31	113	138	90	-- 1a
maker	0	0	0	1	0	1	0	0	0	0	
making	17	15	8	25	5	25	4	16	11	25	
many	517	270	320	378	222	195	134	425	615	477	-- 1a
mark	14	8	14	5	153	10	8	18	23	34	-- 1a
marked	2	15	6	1	26	2	20	2	5	6	
market	0	3	2	4	0	1	0	17	2	1	-- 1b
marketing	0	0	1	0	0	0	0	0	0	0	
marking	1	2	1	0	0	1	0	0	0	0	
measure	61	13	22	58	19	18	12	32	33	25	-- 1a
measured	1	1	8	6	1	11	5	4	8	10	
measuring	15	4	4	1	0	7	2	2	10	9	
measurement	1	0	2	0	0	15	0	0	1	0	-- 5b
middle	4	1	0	4	0	2	1	2	4	2	-- 1b
mile	79	79	101	34	169	112	98	55	135	55	-- 1a
mileage	0	2	0	0	0	0	0	0	0	0	-- 12
million	10	5	3	10	3	0	2	8	21	0	-- 2a

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
millionaire	0	0	0	0	0	0	0	0	1	0	-- 6
minuend	0	5	2	4	9	8	5	8	3	0	-- 20
minus	0	4	1	0	2	0	3	0	0	18	-- 10
minute	63	55	89	46	38	150	88	55	30	150	-- 1b
miss	4	0	0	8	0	0	0	16	13	0	-- 1a
missed	2	0	1	9	0	0	0	2	0	0	
misses	0	0	0	0	0	0	0	0	1	0	
missing	0	2	3	9	51	40	0	16	0	10	-- 9
mistake	15	38	47	31	13	16	16	18	0	32	-- 2a
mix	1	0	0	0	0	0	0	0	0	0	-- 2a
mixed	1	6	10	13	24	2	9	3	7	0	
money	106	128	80	36	93	59	52	94	76	84	-- 1a
month	32	28	38	40	57	4	24	53	53	32	-- 1a
monthly	0	0	0	3	1	0	0	0	0	2	-- 6
more	150	49	66	95	69	113	93	45	88	7	-- 1a
most	3	2	6	8	1	3	12	4	3	2	-- 1a
mostly	0	0	0	0	0	1	0	0	0	0	
move	2	3	1	7	0	0	0	0	0	6	-- 1a
moved	0	0	0	3	0	0	0	0	0	1	
movement	0	0	1	0	0	0	0	0	0	0	-- 3a
moving	1	0	2	3	0	1	0	0	8	0	
much	275	212	305	165	275	226	155	368	311	220	-- 1a
multiplicand	0	15	9	16	16	6	2	5	2	0	
multiplication	38	47	62	68	49	50	20	63	68	49	-- 6
multiplied	0	16	4	3	1	9	0	1	3	23	
multiplier	0	33	18	11	14	5	8	10	6	17	-- 19
multiplies	0	0	0	0	0	1	0	0	0	0	
multiply	26	128	92	103	69	61	43	134	103	182	-- 3a
multiplying	22	23	19	23	3	25	11	58	47	22	
name	51	25	13	22	160	32	15	28	16	22	-- 1a
named	2	0	2	1	0	9	0	0	1	2	
naming	2	2	0	2	0	1	0	0	0	0	
narrow	1	0	1	0	0	0	0	0	0	1	-- 1b
near	0	0	7	5	0	11	0	0	4	5	-- 1a
nearby	0	0	0	0	0	1	0	0	0	0	-- 11
nearer	0	0	1	0	0	1	0	0	0	1	
nearest	0	0	3	3	0	8	0	2	0	1	
nearly	1	1	4	0	0	6	5	1	0	2	-- 3b
need	83	19	84	36	55	78	30	19	40	95	-- 1a
needed	16	16	10	25	11	36	24	5	5	28	
net	2	0	0	0	0	0	5	0	0	0	-- 2b
netting	5	0	0	0	2	3	0	0	1	0	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
never	1	0	1	4	3	0	0	2	0	0	-- 1a
next	23	16	29	36	11	42	23	17	26	83	-- 1a
nickel	38	47	16	8	44	34	17	31	20	42	-- 4b
nine	16	18	30	18	5	10	14	20	7	24	-- 1b
nineteen	0	2	0	3	0	1	0	2	0	0	-- 4a
ninety	2	11	7	4	2	0	1	8	0	2	-- 3b
ninth	2	5	0	13	0	4	2	10	4	0	-- 3a
none	1	2	0	1	2	0	0	0	0	1	-- 1b
note	4	0	3	11	0	3	4	0	3	0	-- 1b
nothing	0	2	3	0	0	2	3	0	1	1	-- 1a
notice	4	2	1	3	4	35	6	3	1	9	-- 1b
noticed	0	0	1	1	0	0	1	0	0	2	
now	36	13	14	33	17	1	25	4	14	52	-- 1a
nowaday	1	0	0	0	0	0	0	0	0	0	-- 8
number	357	360	266	380	202	395	163	322	187	344	-- 1a
numbered	2	2	0	3	0	1	1	0	0	0	
numbering	0	0	2	0	0	0	0	0	0	0	
numeral	3	0	0	1	0	0	0	8	0	2	-- 8
numerator	0	0	0	8	0	0	0	23	7	0	
oblong	0	0	0	4	0	0	0	6	0	0	-- 15
o'clock	11	0	18	8	0	35	3	15	9	9	-- 2a
odd	6	0	0	0	0	0	0	0	0	0	-- 2b
often	1	2	13	5	2	7	6	6	10	11	-- 1a
omit	0	0	0	2	0	2	0	0	1	0	-- 4b
omitted	0	0	0	1	1	1	1	0	0	0	
omitting	0	0	0	4	0	0	0	0	0	0	
once	2	0	7	0	1	1	10	4	0	1	-- 1a
one	275	145	171	277	130	151	154	218	166	269	-- 1a
only	22	6	30	48	6	16	21	10	25	24	-- 1a
opposite	3	1	3	0	4	0	3	0	0	0	-- 2b
order	11	1	11	18	6	35	5	15	6	6	-- 1a
ordered	3	0	4	4	0	5	2	10	4	3	
ordinal	0	0	0	0	0	0	0	1	0	0	
other	38	30	28	61	7	66	16	38	49	78	-- 1a
ounce	12	1	5	9	3	13	29	21	4	20	-- 3b
out	40	23	36	64	45	92	15	23	20	75	-- 1a
outside	3	0	2	3	0	0	0	0	1	1	-- 1b
over	14	42	37	14	5	44	25	54	103	25	-- 1a
overdue	0	0	1	0	0	0	0	2	0	0	-- 20
overweight	0	1	0	0	0	0	0	0	0	0	-- 13
owe	0	0	1	0	3	0	0	0	0	0	-- 2a
owed	0	0	1	0	0	0	0	0	0	0	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
own	5	0	6	11	0	25	6	6	6	1	-- 1a
owned	0	1	0	0	0	1	0	0	0	1	
owner	1	0	0	1	0	0	0	0	1	0	-- 2b
paid	30	37	26	16	39	20	22	57	70	30	-- 2a
pair	24	35	18	12	35	9	14	20	8	11	-- 1b
part	76	64	99	74	8	44	21	55	77	57	-- 1a
partial	0	0	6	35	7	0	0	13	5	0	-- 5b
partly	0	0	0	0	4	1	0	0	0	1	-- 2b
past	1	12	16	0	0	42	1	18	1	15	-- 1b
pay	77	73	72	11	69	44	20	43	85	27	-- 1a
paying	1	1	1	1	0	13	0	0	2	0	
payment	0	1	3	3	0	0	2	0	0	0	-- 3b
peck	11	8	9	5	22	12	32	26	14	15	-- 3b
pennies	19	21	8	27	0	2	3	43	4	18	
penny	0	3	0	4	0	0	1	0	0	1	-- 2b
per	0	0	13	27	120	0	9	0	11	0	-- 2b
perimeter	8	0	0	0	0	0	6	0	5	0	-- 2b
period	3	0	0	1	0	0	1	0	10	3	-- 2b
piece	34	20	43	41	7	20	5	7	68	52	-- 1a
piecing	0	0	0	1	0	0	0	0	0	0	
pint	25	7	22	16	22	17	22	20	5	30	-- 4a
place	50	38	27	106	19	30	14	36	17	7	-- 1a
placed	25	2	2	0	2	7	3	7	1	3	
placing	2	1	1	2	1	0	1	0	1	0	
plan	2	18	8	7	1	9	3	2	4	17	-- 1b
planned	1	3	0	1	0	9	2	0	0	8	
planning	2	0	6	0	0	8	0	0	7	0	
plus	6	2	0	1	0	0	2	3	0	24	-- 8
point	19	13	20	7	6	13	17	18	8	152	-- 1a
pointed	0	0	2	1	0	0	0	2	0	0	
pointing	0	0	0	0	0	1	1	0	1	0	
population	1	11	0	9	3	0	0	0	0	6	-- 3a
position	0	0	0	0	0	4	1	1	0	0	-- 3a
post	12	2	4	3	5	1	2	8	3	11	-- 1b
pound	72	29	36	36	125	9	105	119	68	62	-- 1b
present	5	1	3	2	5	15	4	9	11	10	-- 1a
price	35	69	28	1	98	17	9	15	16	15	-- 1b
priced	1	0	0	0	1	1	1	3	1	0	
principal	1	0	0	0	0	0	0	0	0	0	-- 2b
problem	194	139	90	223	392	335	154	147	195	168	-- 3a
process	4	0	0	7	1	0	0	0	0	0	-- 3a
processes	1	0	0	10	3	0	0	0	0	0	
product	50	110	46	82	44	105	10	71	28	0	-- 2b

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
profit	0	4	0	0	9	0	3	0	0	0	-- 2b
proof	0	0	0	0	17	0	9	3	0	0	-- 2b
proper	0	0	0	0	2	0	3	1	0	0	-- 1b
prove	8	0	0	0	84	3	31	42	0	0	-- 1b
proved	0	0	0	0	0	0	1	0	0	0	
proving	0	0	0	0	1	0	1	2	0	0	
purchase	5	0	0	0	1	0	0	0	0	0	-- 2a
purchased	0	0	0	0	1	0	0	0	0	0	
put	52	25	44	47	18	68	13	40	62	84	-- 1a
putting	4	4	1	0	0	1	1	1	3	7	
quart	74	34	51	35	70	67	65	93	30	58	-- 3b
quarter	18	30	32	15	38	73	33	35	23	51	-- 1b
quotient	74	107	43	64	45	56	21	48	94	0	-- 9
rate	19	0	15	13	5	25	8	10	0	4	-- 2a
real	9	3	0	3	0	1	1	0	0	0	-- 1b
rebuilt	0	0	1	0	0	0	0	0	0	0	-- 20
receipt	0	0	0	0	8	0	0	0	0	0	-- 3b
receive	40	15	6	4	30	6	5	17	4	11	-- 1a
received	12	7	11	10	30	2	32	9	1	20	
record	3	29	9	8	120	84	8	1	1	0	-- 2a
rectangle	6	0	0	6	14	3	3	8	11	26	-- 5b
rectangular	0	0	0	0	0	0	0	0	0	7	-- 8
reduce	0	0	0	12	0	0	2	0	0	0	-- 3a
reduced	1	1	0	3	10	0	1	0	0	0	
reducing	0	0	0	2	0	0	1	0	0	0	
remain	1	0	1	0	0	0	0	0	0	0	-- 1a
remainder	54	77	37	37	52	54	14	40	96	60	-- 3b
remained	3	0	1	0	2	0	0	0	0	0	
remaining	4	3	2	0	7	0	0	1	0	0	
rent	0	0	2	2	4	0	0	3	12	0	-- 2a
rented	0	1	0	0	7	0	0	5	3	0	
renting	0	0	0	0	0	0	0	0	2	0	
repeat	2	0	0	0	0	3	0	2	3	0	-- 2a
repeated	1	0	0	0	2	0	0	2	0	0	
repeating	1	0	0	0	0	0	0	4	0	0	
required	0	0	0	0	1	0	0	0	0	0	
requiring	0	0	0	0	0	1	0	0	0	0	
rest	4	3	6	15	3	5	5	13	12	1	-- 1a
rested	0	0	0	1	0	0	0	0	0	0	
resting	0	0	1	0	0	0	0	0	0	0	
result	0	0	3	0	3	0	3	0	3	0	-- 2a
return	2	0	2	2	0	0	0	0	1	1	-- 1b
returned	2	5	1	1	3	0	0	1	1	8	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
returning	0	1	2	0	0	0	0	0	0	1	
reverse	0	0	0	0	2	0	0	0	29	0	-- 4b
reversed	0	0	0	0	0	0	0	0	3	0	
reversing	1	0	0	0	1	0	0	0	0	0	
rewrite	0	0	0	0	0	1	0	0	0	0	-- 14
right	62	28	56	30	97	48	98	40	95	63	-- 1a
rod	7	0	4	0	0	0	3	1	0	1	-- 2a
round	2	0	10	7	1	0	1	1	12	13	-- 1a
row	120	49	91	101	42	35	29	67	94	199	-- 1b
rule	0	1	1	4	0	2	0	1	1	0	-- 1b
ruled	0	0	0	0	0	0	1	0	0	0	
ruler	11	2	1	2	4	17	6	2	6	14	-- 3a
salaries	0	0	0	0	1	0	0	0	0	0	
salary	0	0	0	0	2	0	0	0	0	0	-- 3a
sale	20	49	12	17	20	6	13	40	12	22	-- 2b
same	36	46	39	10	23	8	18	59	68	65	-- 1a
save	15	8	18	7	37	13	9	19	18	10	-- 1a
saved	11	9	4	14	46	7	8	18	7	18	
saving	7	2	3	4	16	8	10	7	2	2	
scale	4	6	8	0	0	0	2	3	8	0	-- 2a
score	14	0	5	0	224	79	39	4	4	45	-- 2b
scored	0	0	0	1	0	0	4	3	0	0	
scorekeeper	0	0	0	1	0	0	0	0	0	0	
season	1	0	1	0	0	0	0	1	0	0	-- 1b
second	26	18	25	29	17	32	28	45	35	17	-- 1a
section	2	0	0	0	0	0	1	5	0	0	-- 2b
sell	17	24	25	17	27	4	6	47	52	10	-- 1b
selling	10	4	6	4	3	11	1	8	14	4	
separate	5	2	4	1	1	1	2	1	3	2	-- 1b
separated	0	1	2	0	0	0	0	0	0	0	
separately	2	0	0	0	0	0	0	0	0	0	
serve	2	2	4	1	3	0	0	0	0	3	-- 1a
served	0	0	0	2	4	0	0	0	0	2	
set	147	8	21	156	17	47	9	28	12	10	-- 1a
setting	1	0	1	0	0	2	0	0	0	4	-- 1a
seven	25	26	31	26	9	7	9	20	12	23	-- 1b
seventeen	9	0	4	3	0	1	0	0	0	6	-- 4b
seventh	1	1	1	10	1	4	2	8	6	1	-- 3a
seventy	3	4	10	5	6	2	1	4	1	4	-- 2a
several	5	5	4	9	7	4	0	10	8	2	-- 1a
shade	7	0	1	0	0	0	2	0	1	0	-- 1b
shaded	15	0	4	0	0	1	4	0	1	0	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
share	9	14	29	12	20	12	14	7	21	26	-- 2a
shared	2	3	3	5	6	0	3	12	18	5	
sharing	0	1	0	2	0	0	0	0	4	0	
sheet	9	5	10	17	7	1	13	27	4	23	-- 2a
short	2	25	12	18	7	30	1	18	9	23	-- 1a
shorten	0	0	0	2	0	0	0	0	0	0	-- 6
shortened	0	0	0	4	0	0	0	0	0	0	
shortening	0	0	0	4	0	0	0	0	0	0	
shorter	7	0	6	5	4	1	0	1	6	5	
shortest	1	1	0	0	0	0	0	3	0	3	
show	77	53	69	49	2	19	14	52	49	132	-- 1a
showed	3	4	10	1	3	0	4	1	0	5	
showing	1	2	1	4	0	2	2	0	0	6	
shown	7	7	14	9	5	37	4	4	37	31	
side	17	4	15	10	145	18	3	3	18	34	-- 1a
sided	0	0	0	0	1	0	0	0	0	0	
sign	30	30	18	6	7	9	3	30	0	36	-- 1b
signed	0	0	1	0	0	0	3	0	0	0	
signing	0	0	0	0	0	0	1	0	0	0	
simple	0	0	0	1	0	0	5	0	0	0	-- 1b
simpler	1	0	0	0	0	0	0	0	0	0	
simply	0	0	0	0	1	0	0	0	0	0	
since	13	0	1	10	1	22	0	4	24	7	-- 1a
single	1	0	0	0	0	0	2	3	0	0	-- 1b
six	23	29	45	41	25	7	6	45	11	34	-- 1a
sixes	2	2	2	0	0	0	0	0	0	0	
sixteen	12	1	5	2	0	2	0	1	0	4	-- 3b
sixteenth	0	0	0	0	0	0	0	1	0	0	-- 8
sixth	5	19	5	13	5	8	7	26	7	26	-- 2b
sixty	1	7	13	7	5	1	0	7	1	18	-- 3a
size	3	1	8	18	4	5	2	2	6	6	-- 1b
sized	1	0	0	0	0	0	0	0	0	0	
slow	0	1	0	0	0	14	1	0	1	0	-- 1b
slower	0	1	0	0	0	0	0	0	0	0	
slowly	0	0	0	1	0	0	0	0	0	0	
small	23	8	6	14	11	7	11	4	25	5	-- 1a
smaller	9	6	12	16	2	4	2	13	17	25	
smallest	7	1	3	5	0	1	0	0	5	9	
sold	40	83	46	32	97	18	26	101	91	29	-- 1b
solid	0	0	0	0	0	0	0	0	1	0	-- 3a
solve	9	24	0	47	5	84	9	0	1	13	-- 3b
solved	0	3	0	5	0	13	1	0	0	1	
solvers	0	0	0	0	0	0	1	0	0	0	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
solving	15	9	0	31	1	23	14	1	3	1	
some	39	25	29	50	20	43	20	51	48	70	-- 1a
someone	3	0	3	7	3	10	0	2	0	0	-- 3b
something	2	1	3	5	0	5	3	1	3	4	-- 1a
sometimes	8	4	14	10	2	14	11	1	7	5	-- 1a
space	0	1	3	9	29	1	5	5	4	1	-- 1b
spaced	0	0	1	0	0	0	0	0	0	0	
speed	1	0	0	1	44	1	3	0	5	8	-- 2a
speeding	0	1	0	0	0	0	0	0	0	0	
speedometer	8	8	6	5	4	0	0	0	0	0	-- 1a
spend	25	10	29	5	29	16	13	64	25	25	-- 1b
spending	0	0	1	2	0	2	1	2	0	4	
spent	14	12	33	16	46	25	33	45	31	38	-- 2a
square	26	2	25	56	65	10	2	17	18	49	-- 1b
stand	8	3	6	12	3	14	5	18	14	4	-- 1a
standard	0	0	12	0	0	0	0	0	12	44	-- 2b
standing	2	0	0	1	0	0	2	0	3	6	
step	64	51	23	25	68	17	101	37	53	29	-- 1a
stepped	0	0	1	0	0	0	0	0	0	0	
stock	0	2	1	0	0	0	0	0	0	0	-- 1b
stood	1	0	0	0	0	0	0	0	1	0	-- 1b
straight	0	3	5	3	4	2	1	2	1	10	-- 1b
subtract	13	115	57	70	53	73	64	82	62	106	-- 6
subtracted	3	7	0	3	1	5	0	3	3	3	
subtracting	7	10	1	11	3	4	8	19	7	3	
subtraction	33	48	27	43	35	39	25	25	32	21	-- 12
subtrahend	0	7	3	4	10	8	3	7	3	0	-- 19
sum	34	40	39	19	31	95	14	22	14	52	-- 2a
supplied	0	0	0	0	0	0	1	0	0	0	
supplies	1	0	0	4	1	1	3	0	0	0	
supply	2	1	0	2	31	0	0	4	0	2	-- 1b
supplying	0	0	0	2	2	0	0	0	0	0	
suppose	3	0	0	9	0	23	1	1	5	0	-- 1b
supposed	1	0	0	2	0	0	0	0	0	0	
surface	1	0	0	0	1	0	0	0	0	0	-- 2b
table	28	21	5	24	16	5	22	5	20	31	-- 1a
tablespoon	0	2	0	0	0	0	0	0	0	0	-- 12
take	28	10	62	87	65	78	16	28	36	53	-- 1a
taken	3	6	13	3	2	15	2	4	7	8	
taking	6	0	6	2	0	33	0	3	2	3	
tall	5	2	3	11	10	11	9	12	25	28	-- 1b
taller	1	0	1	3	5	0	0	2	4	4	
tallest	0	0	0	0	0	0	0	0	1	1	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
tally	5	0	0	0	0	0	0	0	0	0	-- 10
tallying	1	0	0	0	0	0	0	0	0	0	
tax	4	4	0	0	0	0	0	0	0	0	-- 2a
teaspoon	2	5	0	0	0	0	0	0	0	0	-- 6
teen	0	0	0	0	0	3	0	0	0	0	
tell	78	56	27	93	81	85	11	48	84	71	-- 1a
telling	1	5	4	3	0	9	2	6	0	2	
temperature	11	13	16	23	2	0	37	19	23	25	-- 3b
ten	131	37	63	114	27	20	22	40	4	21	-- 1a
tenth	1	7	0	12	0	1	2	1	0	1	-- 3a
term	0	1	0	18	0	0	6	29	2	1	-- 2a
then	81	103	90	115	206	172	30	68	82	94	-- 1a
there	277	37	87	107	120	107	114	169	186	115	-- 1a
thermometer	16	6	8	14	0	0	1	9	6	21	-- 5b
thick	0	0	1	1	0	0	1	0	1	3	-- 1b
thin	1	0	0	0	0	0	0	0	0	0	-- 1b
think	123	16	36	59	90	103	12	73	71	92	-- 1a
thinking	3	8	1	2	0	14	2	0	0	0	
third	27	39	17	24	14	26	11	28	13	36	-- 1a
thirteen	9	1	2	3	2	3	1	0	0	3	-- 3a
thirty	8	3	12	7	5	4	3	12	2	9	-- 2a
thought	3	0	13	13	0	4	5	0	3	9	-- 1a
thousand	42	36	34	50	22	43	16	28	21	57	-- 1a
three	66	57	40	56	45	39	29	47	24	61	-- 1a
thrift	0	0	0	1	0	0	0	0	0	0	-- 9
time	61	74	98	113	77	118	108	90	82	175	-- 1a
timekeeper	0	1	0	0	0	0	0	0	0	0	
timed	1	5	0	0	0	0	0	0	1	0	
timing	0	1	0	0	0	1	0	0	0	0	
tiny	0	0	1	0	0	4	0	0	0	0	-- 2b
together	24	3	15	31	1	6	24	7	36	5	-- 1a
told	8	4	6	13	1	9	2	8	6	38	-- 1b
ton	0	1	15	25	20	0	12	12	10	17	-- 3a
took	12	5	25	30	5	20	18	25	17	22	-- 1a
top	14	4	23	13	98	11	14	8	4	23	-- 1a
total	10	18	26	45	64	8	61	3	4	11	-- 2a
toward	1	1	2	2	1	2	1	2	1	1	-- 1b
trade	6	0	0	0	0	0	0	0	0	1	-- 1b
traded	5	0	1	0	0	0	0	0	0	1	
trader	1	0	0	0	0	0	0	0	0	0	-- 5a
trading	8	0	0	0	0	0	0	0	0	0	
treasurer	0	0	0	0	0	0	1	3	0	0	-- 6
triangle	8	0	0	0	0	0	2	0	4	6	-- 6

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
tried	5	0	0	3	0	3	0	1	2	0	-- 2a
tries	0	0	0	0	0	2	0	1	0	0	
trip	9	31	20	31	19	32	14	24	68	29	-- 1b
try	10	15	16	12	26	69	7	4	21	18	-- 1a
trying	1	1	0	1	0	2	1	1	1	1	
twelfth	0	2	0	1	0	0	0	1	0	0	
twelve	17	0	6	6	9	6	2	4	2	5	-- 1b
twenties	0	0	0	0	0	3	0	0	0	0	
twentieth	0	0	0	1	0	0	0	0	0	0	-- 6
twenty	17	14	28	8	16	8	6	17	2	7	-- 1b
twice	3	0	2	16	1	1	9	10	5	10	-- 2a
twin	2	0	0	0	0	1	0	1	0	0	-- 3a
two	128	95	64	132	63	50	53	76	75	118	-- 1a
under	8	49	61	24	5	15	7	27	25	33	-- 1a
underweight	0	1	0	4	0	0	0	0	0	1	
undivided	0	0	3	0	0	0	0	0	0	0	-- 14
uneven	10	0	1	6	0	0	2	0	8	0	-- 6
unit	4	15	0	0	23	9	10	18	5	0	-- 6
unlike	0	0	0	6	0	0	0	0	0	0	-- 4b
up	23	3	37	28	0	43	23	17	22	36	-- 1a
upkeep	1	0	0	0	0	0	0	0	0	0	-- 15
upon	0	0	0	0	0	1	0	0	0	0	-- 1a
upper	2	0	1	3	0	9	1	1	3	2	-- 2a
upward	0	0	0	2	8	0	2	0	0	0	-- 3a
use	59	53	41	111	20	112	19	43	20	91	-- 1a
used	38	23	14	72	16	43	17	33	25	29	
using	18	30	10	26	3	6	10	23	25	17	
usual	0	1	0	5	6	0	0	0	0	0	-- 1b
usually	7	4	2	5	1	1	1	3	3	1	
value	15	1	1	0	7	5	4	12	4	0	-- 1b
volume	0	0	0	0	0	0	0	0	1	0	-- 3a
wage	0	0	0	0	2	0	0	0	0	0	-- 2b
way	52	61	48	79	8	85	18	55	52	87	-- 1a
week	48	38	77	59	71	30	92	56	142	94	-- 1a
weekly	0	0	0	0	2	0	0	0	1	0	-- 5b
weigh	26	15	17	41	34	3	34	21	47	10	-- 2a
weighed	7	2	7	18	6	1	15	6	12	11	
weighing	0	1	0	3	1	0	2	2	3	6	
weight	8	10	18	15	18	0	26	11	20	3	-- 1b
what	185	185	218	150	206	163	58	139	180	264	-- 1a
where	15	13	16	4	14	8	4	27	28	28	-- 1a
which	88	36	70	80	17	39	25	56	121	96	-- 1a
whole	11	9	38	31	17	11	19	9	26	9	-- 1a

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
wide	14	1	21	13	38	31	6	2	7	30	-- 1a
wider	0	0	0	0	0	1	0	0	1	1	
widest	0	0	0	0	0	0	0	0	3	0	
width	2	0	3	5	8	7	7	1	0	8	-- 3a
win	2	0	0	0	0	2	1	0	4	3	-- 1b
winner	2	0	0	0	0	3	0	1	0	0	
winning	0	0	0	0	0	1	0	0	0	0	
with	136	59	124	100	60	193	53	99	83	110	-- 1a
within	0	0	0	0	0	2	0	0	0	1	-- 1b
without	18	23	31	16	2	26	5	36	18	59	-- 1a
won	14	1	1	3	1	3	1	4	5	0	-- 2a
work	103	25	101	90	314	71	58	87	172	59	-- 1a
worked	14	0	13	8	24	3	4	41	15	17	
worker	0	0	1	0	0	0	0	1	0	21	-- 3b
working	7	0	3	3	7	0	6	11	3	6	
worth	4	4	10	7	5	3	7	7	5	13	-- 1b
write	112	132	182	180	284	243	69	151	141	174	-- 1a
writing	9	12	4	9	14	27	0	9	17	13	
written	22	16	16	26	10	55	7	26	22	57	-- 2a
wrong	2	1	1	5	66	9	7	1	4	10	-- 1b
wrote	3	2	11	9	0	3	3	1	1	19	-- 2b
yard	43	33	23	16	87	0	132	98	35	68	-- 1b
yardstick	0	1	0	0	0	2	6	1	0	0	
year	49	42	65	80	57	16	52	61	108	75	-- 1a
zero	26	52	19	7	4	32	23	32	24	27	-- 5a
Arabic figure	0	0	0	0	0	2	0	0	0	0	
Arabic number	0	0	0	0	2	1	9	0	0	0	
common denominator	0	0	0	0	0	0	0	4	0	0	
decimal point	18	17	0	0	12	0	11	15	7	0	
mixed number	0	0	0	18	0	0	4	0	0	0	
Roman number	0	0	2	1	0	0	4	0	0	0	
Roman numeral	5	2	5	9	0	3	0	22	12	12	
whole number	0	0	0	9	0	0	6	5	0	0	
Abbreviations											
amt. (amount)	0	0	0	0	2	0	0	0	0	0	
ans. (answer)	0	0	2	0	0	6	0	0	0	0	-- 20
bu. (bushel)	1	14	4	23	17	10	7	6	5	19	-- 6
c. (cup)	0	0	0	22	0	0	0	0	0	0	-- 6
cu. (cubic)	0	0	0	0	3	0	0	0	0	0	-- 10
c. w. t. (hundredweight)	0	0	1	0	0	0	0	0	1	0	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals										Thorndike's Placement
	I	II	III	IV	V	VI	VII	VIII	IX	X	
da. (day)	1	0	8	24	41	0	3	5	2	10	-- 13
doz. (dozen)	1	34	42	21	30	0	7	10	10	4	-- 7
ea. (each)	0	0	7	0	0	0	0	0	0	0	
ex. (example or exercise)	0	0	0	149	0	2	0	0	18	0	
ft. (foot)	7	30	78	65	136	39	27	10	95	125	-- 4a
gal. (gallon)	14	50	14	35	58	5	14	5	6	18	-- 7
gro. (gross)	0	0	0	0	0	0	0	2	0	0	
hr. (hour)	3	9	19	24	16	0	8	6	31	14	-- 7
in. (inch)	13	45	32	45	62	54	38	16	85	63	-- 6
lb. (pound)	4	27	99	94	31	10	44	36	47	50	-- 4b
mi. (mile)	1	1	3	44	3	5	0	8	12	35	-- 7
min. (minute)	2	11	36	23	17	0	5	6	30	17	-- 12
mo. (month)	1	2	4	7	11	0	1	3	4	4	
no. (number)	0	0	1	0	30	223	5	1	2	8	-- 12
oz. (ounce)	2	1	5	19	8	2	15	9	3	22	-- 4b
pk. (peck)	1	9	4	10	37	10	14	5	5	33	-- 7
pr. (pair)	1	0	1	0	6	0	0	0	0	0	
prob. (problem)	0	0	1	0	0	0	0	0	0	0	
pt. (pint)	4	19	12	19	36	8	8	7	6	5	-- 6
qt. (quart)	56	27	19	37	116	9	26	22	9	29	-- 5a
R. (remainder)	0	0	0	19	61	0	3	0	11	0	
r. (remainder)	27	34	51	0	0	268	0	26	0	66	
rd. (rod)	1	0	1	0	0	0	0	0	0	0	-- 20
rem. (remainder)	0	0	0	0	0	0	0	0	0	7	
sec. (second)	0	0	5	2	4	0	1	2	8	0	
sq. (square)	0	0	0	8	89	0	0	0	0	1	-- 6
T. (ton)	0	1	3	7	0	0	0	2	8	23	
vol. (volume)	0	0	0	0	0	0	0	0	17	0	
wk. (week)	1	2	9	14	24	0	3	2	5	6	-- 12
wt. (weight)	0	0	0	0	0	0	1	0	0	0	
yd. (yard)	5	29	19	40	99	16	44	10	18	39	-- 5a
yr. (year)	1	1	12	9	11	0	1	3	19	6	-- 11
Signs											
+ (plus)	174	171	149	774	119	312	515	278	254	435	
- (minus)	414	70	50	610	161	214	526	210	60	682	
x (times)	470	420	256	981	308	528	409	371	254	839	
÷ (divided by)	37	288	25	232	22	96	89	209	73	134	

TABLE I (Continued)

A TABLE SHOWING THE FREQUENCY OF ARITHMETICAL CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE'S RATINGS OF CONCEPTS

Concept	Textbooks Indicated by Roman Numerals									Thorndike's
	I	II	III	IV	V	VI	VII	VIII	IX	X Placement
= (equal)	98	1260	436	627	891	777	1018	723	323	732
" (inches)	0	0	0	0	0	15	0	0	0	0
° (degree)	19	24	28	39	0	0	70	0	20	32
$ (dollar)	967	674	808	627	629	768	924	1012	1154	708
@ (at)	0	0	0	8	0	0	0	0	7	0
¢ (cent)	322	281	527	213	348	351	80	381	267	302
√ (division)	1221	591	1490	1118	2048	1606	1175	1113	2094	1968

The preceding table shows that there is a wide variation in the number of times different words occur. It also shows a wide variation in the different words used by the different authors. For example, one author used the word "between" 104 times, whereas another author used the same word only four times. Another author used the word "accuracy" 121 times, but this same word is not used by any of the other authors in the textbooks.

A more comprehensive study will be made of Table I in Tables II, III, and IV.

The Level of Difficulty of Concepts

The following table shows the number of words which are rated by Thorndike. It also gives the number of words rated below the 4000 word level and from this data it is possible to find the per cent of words that Thorndike would list as too difficult for the fourth grade.

TABLE II

TABLE SHOWING THE PER CENT OF ARITHMETICAL CONCEPTS USED BY EACH TEXTBOOK WHICH APPEAR ABOVE THE THORNDIKE 4000 WORD LEVEL

	Textbooks Indicated by Roman Numerals									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Number of concepts rated	447	370	441	441	379	389	415	409	406	391
Below 4000 word level	389	326	378	381	332	346	365	355	347	345
Per cent above 4000 word level	12.9	11.9	14.3	13.6	12.4	11.1	12.0	13.2	14.5	11.8

The per cent of words above the 4000 word level varies from 11.1 to 14.5 in the textbooks studied. This variation is not very great, but the fact that from 10 to 15 per cent of the arithmetical concepts used in an average fourth-grade arithmetic textbook are too difficult for the grade, is of more serious consequence. It can be argued that such words as "denominator", "numerator", "minus", and "plus" must be introduced, in order to acquaint the pupil with terminology used in the fundamental processes of arithmetic, but these words make up a very small number of the total words which are too difficult.

The Frequencies of the Different Concepts

The number of times a word must be used before it will become a part of the pupil's permanent vocabulary has not been determined scientifically. Several factors would influence this number. First, it would depend on the individual differences of the pupils. Some pupils acquire a new word the first time they come in contact with it; others could come in contact with the same word fifty times and still not acquire the word.

Secondly, it would depend on the number of different places the word is found in the textbook. The word may be found fifty times on one or two pages of the textbook; yet, after two week's time the pupil may have forgotten the word. Thirdly, it would depend on the manner in which the word is used in the book or the manner in which the word is explained by the instructor.

In Table III the concepts occurring only one time, two through five times, six through nine times, ten through nineteen times, and those occurring more than twenty times have been tabulated. In Table IV the percentages for each of the above frequencies have been calculated.

TABLE III

NUMBER AND FREQUENCY OF DIFFERENT CONCEPTS USED IN EACH OF THE TEN FOURTH-GRADE ARITHMETIC TEXTBOOKS

Textbook	Frequency					Number of different concepts
	1	2-5	6-9	10-19	20 or more	
I	108	154	61	96	168	587
II	91	122	49	66	160	488
III	95	156	71	89	171	582
IV	62	177	83	105	176	603
V	72	126	51	68	175	492
VI	81	122	74	71	171	519
VII	87	157	85	84	129	542
VIII	83	132	64	91	173	543
IX	85	127	70	85	168	535
X	65	107	54	86	203	515

TABLE IV

THE PERCENTAGE FOR EACH FREQUENCY OF DIFFERENT CONCEPTS USED IN EACH OF THE TEN FOURTH-GRADE ARITHMETIC TEXTBOOKS

Textbook	Frequency				
	1	2-5	6-9	10-19	20 or more
I	18.4	26.2	10.4	16.4	28.6
II	18.6	25.0	10.2	13.5	32.7
III	16.3	26.8	12.2	15.3	29.4
IV	10.3	29.3	13.8	17.4	29.2
V	14.6	25.6	10.4	13.8	35.6
VI	15.6	23.5	14.3	13.7	32.9
VII	16.1	28.9	15.7	15.5	23.8
VIII	15.3	24.3	11.8	16.8	31.8
IX	15.8	23.8	13.1	15.9	31.4
X	12.6	20.8	10.5	16.7	39.4

Words used less than twenty times account for 60.6 per cent to 76.2 per cent and words used only one time account for 10.3 per cent to 18.4 per cent of the total arithmetical concepts used by the ten textbooks.

The Distribution of Concepts as Used by the Different Textbooks

Table V is the result of a study made to determine how widely the various arithmetical concepts are used by the different authors. It also shows the total number of times each concept is used by the ten books.

TABLE V

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
about	10	438	back	10	177
above	10	373	balance	2	13
account	4	31	bank	10	177
accuracy	1	121	banker	1	2
accurate	2	2	banking	1	3
accurately	2	3	bargain	2	2
acre	4	37	barrel	2	15
add	10	834	barter	1	2
added	10	57	base	2	8
addend	5	19	basic	1	2
adding	10	214	before	10	277
addition	10	313	began	10	41
additive	2	4	begin	10	133
after	10	348	beginning	10	40
afterward	2	2	begun	3	3
again	10	213	behind	4	8
age	4	14	below	10	667
ago	7	29	beside	8	36
alike	8	17	best	8	49
all	10	1097	better	9	41
allow	3	9	between	10	288
allowance	6	37	big	10	65
allowed	4	7	biggest	1	1
almost	3	7	bill	10	208
already	8	27	block	9	82
altogether	4	17	borrow	8	31
always	10	81	borrowed	4	19
among	10	82	borrowing	5	12
amount	10	265	both	10	188
amounted	5	8	bottom	10	90
amounting	4	7	bought	10	838
angle	1	4	bring	10	144
annex	3	8	bringing	4	5
annexed	1	1	broad	1	4
annexing	3	6	brought	10	101
another	10	155	build	4	10
answer	10	2645	builder	1	1
answered	5	28	building	8	42
answering	2	2	built	10	25
any	10	338	bunch	7	36
anyone	3	10	bunches	8	43
anything	7	23	bundle	2	8
apart	5	10	bushel	10	266
apiece	8	121	business	6	15
area	3	42	buy	10	600
arithmetic	10	108	buyer	1	3
around	10	154	buying	10	97
article	4	28	calendar	9	49
average	10	520	carried	10	74
averaged	3	12	carries	4	5
away	10	68	carry	10	149

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
carrying	9	71	counting	9	40
cash	6	48	coupon	1	3
cashier	3	26	credit	1	1
census	1	1	cube	1	2
cent	10	1549	cubic	1	6
center	6	18	cup	7	49
centuries	1	3	cupful	6	29
century	3	9	customer	1	1
certain	8	17	daily	6	42
change	10	541	date	10	60
changed	7	13	day	10	1282
changing	6	12	debt	1	2
charge	6	29	decade	3	13
charged	6	23	decomposition	1	2
cheaper	7	16	decimal	1	1
cheapest	2	2	deep	4	7
check	10	724	degree	9	69
checked	5	34	deliver	8	38
checking	8	85	delivered	7	28
circle	8	158	deliveries	1	1
coin	9	110	delivering	5	8
collect	6	18	delivery	4	12
collected	9	19	denominate	2	10
collecting	4	4	denomination	1	3
collection	3	8	denominator	3	42
column	10	278	deposit	2	9
combination	5	91	deposited	1	4
common	3	4	depth	1	3
company	5	8	diagonal	1	6
compare	8	81	diagram	1	1
compared	2	2	dial	1	1
comparing	2	5	difference	10	200
comparison	1	1	different	10	99
compass	1	1	digit	1	2
compasses	1	2	dime	10	283
complete	7	37	dimension	2	4
completed	3	6	distance	10	179
completely	1	1	divide	10	930
completing	1	1	divided	10	318
cone	6	20	dividend	8	145
contain	9	33	dividing	10	176
contained	6	61	divisible	1	1
containing	4	6	division	10	760
correct	9	314	divisor	10	150
corrected	1	1	dollar	10	687
correcting	1	2	dot	8	56
correctly	10	116	double	3	12
cost	10	1343	doubled	2	6
costing	7	25	doubling	1	1
count	10	175	down	10	204
counted	9	77	downward	2	10

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
dozen	10	505	express	5	7
dry	7	30	expressed	1	1
due	5	30	extra	8	132
during	9	115	fact	10	555
each	10	3607	factor	1	1
earlier	2	2	far	10	182
early	7	13	faraway	1	2
earn	10	167	fare	8	51
earned	10	209	farther	10	56
earning	9	19	farthest	3	3
edge	6	14	fast	9	40
eight	10	155	faster	6	14
eighteen	6	25	fastest	4	10
eighteenth	1	1	feet	10	503
eighth	10	134	few	5	9
eighty	10	31	fewer	5	37
either	8	8	fewest	1	1
eleven	7	20	fifteen	7	36
eleventh	1	1	fifth	10	114
else	6	18	fiftieth	1	1
elsewhere	1	1	fifty	10	70
emptied	1	1	figure	10	686
empty	7	14	figured	3	8
end	10	135	figuring	1	11
ended	3	4	fill	10	164
ending	7	21	filled	8	41
enough	10	124	filling	6	23
entire	3	4	final	4	8
equal	10	474	finally	1	1
equalled	1	1	find	10	1552
equally	10	207	finding	10	89
even	7	49	first	10	611
evenly	7	32	five	10	393
ever	7	24	follow	10	52
every	10	114	followed	1	1
everybody	1	1	following	10	200
everyday	3	9	foot	10	105
everyone	5	6	form	5	10
everything	5	6	formed	6	7
everywhere	1	1	forty	10	66
exact	6	14	found	10	213
exactly	8	35	four	10	422
example	10	1060	fourteen	6	19
except	8	20	fourth	10	305
excepting	1	2	fraction	10	367
exchange	3	5	fractional	6	26
exchanged	2	2	from	10	1390
exchanging	1	4	front	9	32
exercise	8	212	full	8	31
expense	8	91	fund	3	6
expensive	1	4	further	1	1

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
gain	5	34	interest	1	1
gained	5	18	interesting	7	12
gallon	10	343	intermediate	1	2
gave	10	367	into	10	426
give	10	604	inventory	1	6
given	10	341	item	3	7
giving	9	35	keep	10	94
gone	10	41	keeping	5	29
graph	3	17	kept	10	54
great	4	6	kind	9	120
greater	6	16	laid	7	25
greatest	2	2	large	10	214
greatly	1	2	larger	10	134
gross	2	13	largest	9	52
group	10	201	last	10	306
grouped	1	6	lasted	5	7
half	10	389	late	9	26
halves	9	52	later	6	13
hand	10	198	lay	6	12
handed	6	32	laying	1	1
handing	1	6	learn	10	116
heavier	5	10	learned	10	63
heaviest	3	4	learning	5	51
heavily	1	1	least	7	21
heavy	8	19	left	10	682
height	9	63	length	10	133
held	6	25	lent	1	1
hence	1	16	less	10	172
high	10	89	lesser	1	2
higher	8	29	light	6	20
highest	6	20	lighter	2	2
hired	3	3	lightest	1	1
hold	9	59	lightly	1	1
holding	5	20	like	10	298
horsepower	2	7	liked	3	7
hour	10	744	liking	1	1
how	10	7066	line	10	223
hundred	10	462	linear	1	1
hundredweight	2	5	lined	2	2
inch	10	157	lining	1	1
inches	10	617	list	9	58
include	2	10	listed	1	1
including	4	30	little	10	116
incomplete	1	1	loan	1	2
incorrect	2	3	long	10	707
incorrectly	2	3	longer	10	49
increase	1	2	longest	4	8
increased	4	5	lose	5	6
inside	6	12	loss	2	2
instead	8	53	lost	8	21
insure	1	3	lot	7	48

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
low	3	6	named	6	17
lower	8	22	naming	4	7
lowest	7	48	narrow	3	3
made	10	469	near	5	32
make	10	926	nearby	1	1
maker	2	2	nearer	3	3
making	10	151	nearest	5	17
many	10	3553	nearly	7	20
mark	10	287	need	10	539
marked	10	85	needed	10	176
market	7	30	net	2	7
marketing	1	1	netting	4	11
marking	4	5	never	5	11
measure	10	293	next	10	316
measured	10	55	nickel	10	297
measuring	9	54	nine	10	162
measurement	4	19	nineteen	4	8
middle	8	20	ninety	8	37
mile	10	917	ninth	7	40
mileage	1	2	none	5	7
million	8	62	note	6	28
millionaire	1	1	nothing	6	12
minuend	8	44	notice	10	68
minus	5	28	noticed	4	5
minute	10	764	now	10	209
miss	4	41	nowadsy	1	1
missed	4	14	number	10	2976
misses	1	1	numbered	5	9
missing	7	131	numbering	1	2
mistake	9	226	numeral	4	14
mix	1	1	numerator	3	38
mixed	9	75	oblong	2	10
money	10	808	o'clock	8	108
month	10	361	odd	1	6
monthly	3	6	often	10	63
more	10	775	omit	3	5
most	10	44	omitted	4	4
mostly	1	1	omitting	1	4
move	10	19	once	7	26
moved	2	4	one	10	1956
movement	1	1	only	10	208
moving	5	15	opposite	5	14
much	10	2512	order	10	114
multiplicand	8	71	ordered	8	35
multiplication	10	514	ordinal	1	1
multiplied	8	60	other	10	411
multiplier	9	122	ounce	10	117
multiplies	1	1	out	10	433
multiply	10	941	outside	5	10
multiplying	10	253	over	10	363
name	10	384	overdue	2	3

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
overweight	1	1	proving	3	4
owe	2	4	purchase	2	6
owed	1	1	purchased	1	1
own	8	66	put	10	453
owned	3	3	putting	8	22
owner	3	3	quart	10	577
paid	10	347	quarter	10	348
pair	10	186	quotient	10	552
part	10	575	rate	8	99
partial	5	66	real	5	17
partly	3	6	rebuilt	1	1
past	8	106	receipt	1	8
pay	10	521	receive	10	138
paying	6	19	received	10	134
payment	4	9	record	9	263
peck	10	154	rectangle	8	77
pennies	9	145	rectangular	1	7
penny	4	9	reduce	2	14
per	5	180	reduced	5	16
perimeter	3	19	reducing	2	3
period	5	18	remain	2	2
piece	10	297	remainder	10	521
piecing	1	1	remained	3	6
pint	10	186	remaining	5	17
place	10	344	rent	5	23
placed	9	52	rented	4	16
placing	7	9	renting	1	2
plan	10	71	repeat	4	10
planned	6	24	repeated	3	5
planning	4	23	repeating	2	5
plus	6	38	required	1	1
point	10	273	requiring	1	1
pointed	3	5	rest	10	67
pointing	3	3	rested	1	1
population	5	30	resting	1	1
position	3	6	result	4	12
post	10	51	return	5	8
pound	10	661	returned	8	22
present	10	65	returning	3	4
price	10	303	reverse	2	31
priced	5	7	reversed	1	3
principal	1	1	reversing	2	2
problem	10	2037	rewrite	1	1
process	3	12	right	10	617
processes	3	14	rod	5	16
product	9	546	round	8	47
profit	3	16	row	10	827
proof	3	29	rule	6	10
proper	3	6	ruled	1	1
prove	5	168	ruler	10	65
proved	1	1	salaries	1	1

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
salary	1	2	since	8	82
sale	10	211	single	3	6
same	10	372	six	10	266
save	10	154	sixes	3	6
saved	10	142	sixteen	7	27
saving	10	61	sixteenth	1	1
scale	6	31	sixth	10	121
score	8	414	sixty	9	60
scored	3	8	size	10	55
scorekeeper	1	1	sized	1	1
season	3	3	slow	4	17
second	10	272	slower	1	1
section	3	8	slowly	1	1
sell	10	229	small	10	114
selling	10	65	smaller	10	106
separate	10	22	smallest	7	31
separated	2	3	sold	10	563
separately	1	2	solid	1	1
serve	6	15	solve	8	192
served	3	8	solved	5	23
set	10	455	solvers	1	1
setting	4	8	solving	9	98
seven	10	188	some	10	395
seventeen	5	23	someone	6	28
seventh	10	35	something	9	27
seventy	10	40	sometime	10	76
several	9	54	space	9	58
shade	4	11	spaced	1	1
shaded	5	25	speed	7	63
share	10	164	speeding	1	1
shared	9	57	speedometer	5	31
sharing	3	7	spend	10	241
sheet	10	116	spending	6	12
short	10	145	spent	10	293
shorten	1	2	square	10	270
shortened	1	4	stand	10	87
shortening	1	4	standard	3	68
shorter	8	35	standing	5	14
shortest	4	8	step	10	468
show	10	516	stepped	1	1
showed	8	31	stock	2	3
showing	7	18	stood	2	2
shown	10	155	straight	9	31
side	10	267	subtract	10	695
sided	1	1	subtracted	8	28
sign	9	169	subtracting	10	73
signed	2	4	subtraction	10	328
signing	1	1	subtrahend	8	45
simple	2	6	sum	10	360
simpler	1	1	supplied	1	1
simply	1	1	supplies	5	10

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency	Concept	Number Books	Total Frequency
supply	6	42	traded	3	7
supplying	2	4	trader	1	1
suppose	6	42	trading	1	8
supposed	2	3	treasurer	2	4
surface	2	2	triangle	4	20
table	10	177	tried	5	14
tablespoon	1	2	tries	2	3
take	10	463	trip	10	277
taken	10	63	try	10	198
taking	7	55	trying	8	9
tall	10	116	twelfth	3	4
taller	7	20	twelve	9	57
tallest	2	2	twenties	1	3
tally	1	5	twentieth	1	1
tallying	1	1	twenty	10	123
tax	2	8	twice	9	57
teaspoon	2	7	twin	3	4
teen	1	3	two	10	854
tell	10	634	under	10	254
telling	8	32	underweight	3	6
temperature	9	169	undivided	1	3
ten	10	479	uneven	5	27
tenth	7	25	unit	7	84
term	6	57	unlike	1	6
then	10	1041	up	9	232
there	10	1319	upkeep	1	1
thermometer	8	81	upon	1	1
thick	5	7	upper	8	22
thin	1	1	upward	3	12
think	10	675	use	10	569
thinking	6	30	used	10	310
third	10	235	using	10	168
thirteen	8	24	usual	3	12
thirty	10	65	usually	10	28
thought	7	50	value	8	49
thousand	10	349	volume	1	1
three	10	464	wage	1	2
thrift	1	1	way	10	545
time	10	996	week	10	707
timekeeper	1	1	weekly	2	3
timed	3	7	weigh	10	248
timing	2	2	weighed	10	85
tiny	2	5	weighing	7	18
together	10	152	weight	9	129
told	10	95	what	10	1748
ton	8	112	where	10	145
took	10	179	which	10	628
top	10	212	whole	10	180
total	10	250	wide	10	163
toward	8	12	wider	3	3
trade	2	7	widest	1	3

TABLE V (Continued)

TABLE SHOWING THE NUMBER OF BOOKS IN WHICH THE ARITHMETICAL CONCEPT APPEARS AND THE TOTAL NUMBER OF TIMES EACH CONCEPT IS USED BY THE TEN BOOKS

Concept	Number Books	Total Frequency
width	8	41
win	5	12
winner	3	6
winning	1	1
with	10	1017
within	2	3
without	10	234
won	9	33
work	10	1080
worked	9	139
worker	3	23
working	8	46
worth	10	65
write	10	1668
writing	9	114
written	10	257
wrong	10	106
wrote	9	52
yard	9	535
yardstick	4	10
year	10	605
zero	10	246
Arabic figure	1	2
Arabic number	3	12
common denominator	1	4
decimal point	6	80
mixed number	2	22
Roman number	3	7
Roman numeral	8	70
whole number	3	20
Abbreviations		
amt. (amount)	1	2
ans. (answer)	2	8
bu. (bushel)	10	106
c. (cup)	1	22
cu. (cubic)	1	3
c. w. t. (hundred-weight)	2	2
da. (day)	8	94
doz. (dozen)	9	158
ea. (each)	1	7
ex. (example or exercise)	3	169
ft. (feet)	10	612
gal. (gallon)	10	220
gro. (gross)	1	2
hr. (hour)	9	130
in. (inch)	10	453
lb. (pound)	10	442
mi. (mile)	9	112
min. (minute)	9	147
mo. (month)	9	37
no. (number)	7	270
oz. (ounce)	10	86
pk. (peck)	10	128
pr. (pair)	3	8
pro. (problem)	1	1
pt. (pint)	10	124
qt. (quart)	10	350
R. (remainder)	4	94
r. (remainder)	6	422
rd. (rod)	2	2
rem. (remainder)	1	7
sec. (second)	6	22
sq. (square)	3	98
T. (ton)	6	43
vol. (volume)	1	16
wk. (week)	9	66
wt. (weight)	1	1
yd. (yard)	10	319
yr. (year)	9	63
Signs		
+ (plus)	10	3181
- (minus)	10	2997
x (times)	10	4836
÷ (divided by)	10	1205
= (equal)	10	6885
" (inches)	1	15
° (degree)	7	232
$ (dollar)	10	8271
@ (at)	2	15
¢ (cent)	10	3072
√ (division)	10	14424

The preceding table shows that there is a wide variation in the different words used by the different authors. Of the total 895 concepts, only 286, or 31. 9 per cent, are common to all ten textbooks.

The ten words used the greatest number of times by the ten authors rank as follows: how (7066), each (3607), many (3553), number (2976), answer (2645), much (2512), problem (2037), one (1956), find (1852), and what (1748). Of the signs, the division sign occurs the greatest number of times, occurring 14,424 times in the ten textbooks.

It is sometimes desirable to compare one textbook with another to determine the number of arithmetical concepts common to both books. Table VI gives this information for the ten textbooks studied.

TABLE VI

NUMBER OF WORDS COMMON TO ANY TWO TEXTBOOKS

Textbook	I	II	III	IV	V	VI	VII	VIII	IX	X
I	...	414	462	485	405	431	439	454	442	448
II	...	...	415	424	380	391	404	462	394	401
III	...	...	...	479	412	437	438	463	451	451
IV	...	...	...	...	421	441	456	463	459	462
V	...	...	...	...	...	377	397	408	394	385
VI	...	...	...	...	...	...	414	429	412	416
VII	...	...	...	...	...	...	...	434	422	426
VIII	...	...	...	...	...	...	...	...	437	432
IX	...	...	...	...	...	...	...	...	...	433
X	...	...	...	...	...	...	...	...	...	...
Number of different concepts	587	488	582	603	492	519	542	543	535	515

The percentage of concepts common to any two of the textbooks studied ranges from 35 per cent to 40 per cent in all cases.

CHAPTER 4

CONCLUSIONS

From the results of this study the three following major conclusions may be drawn:

1. The arithmetical vocabularies used in the various fourth-grade arithmetic textbooks are too difficult for the vocabulary attainment of the grade. The findings show that 11.1 per cent to 14.5 per cent of the arithmetical concepts used are above the fourth grade level of attainment as rated by Thorndike.

2. It is questionable if the different arithmetical concepts are used a sufficient number of times to become a permanent part of the pupil's vocabulary. Words used only once account for 10.3 per cent to 18.4 per cent of the total number of concepts studied. Words used less than twenty times account for 60.6 per cent to 76.2 per cent of the total. Although the number of times a word must appear before the pupil will acquire it in his vocabulary is not known, it is known that the learning process should be facilitated if the words occur a great number of times. Since some words are used thousands of times and other words are used only a few times, it would be reasonable to assume that an arithmetic book would become a more efficient tool of learning if all the words used were more evenly distributed as far as frequency is concerned.

3. There is a wide variation in the different words used by the different authors. Of the total 895 arithmetical concepts used in this study, only 286, or 31.9 per cent, were used by all the textbooks. The arithmetical words appearing the greatest number of times in the ten textbooks were "how", "each", "many", "number", "answer", "much", "problem", "one", "find", and "what"; the word "how" appearing nearly twice as often as any other word.

The teaching of arithmetic in the lower elementary grades is a complex procedure, since the pupil must be taught not only words, but also must be taught to read combinations of numbers and words. The learning process becomes still more complex when one considers the technical vocabulary which is introduced in arithmetic. It would be logical to assume that the arithmetical vocabularies should be more scientifically constructed in order to facilitate the learning process. A scientific vocabulary construction is principally a vocabulary which would be made up of words occurring a sufficient number of times to become a permanent part of the pupil's vocabulary, and the exclusion of terms that are too difficult for the grade level.

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